REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections set forth in the Office Action of July 14, 2004 is respectfully requested.

The Examiner rejected dependent claims 46 and 48 under 35 USC § 112, first paragraph, as failing to comply with the written description requirement. As explained to the Examiner during the interview of October 18, 2004, the subject matter recited in dependent claims 46 and 48 is disclosed in paragraph [0013] of the substitute specification submitted with the Amendment of October 6, 2003. Nonetheless, the Examiner is requested to note that dependent claims 46 and 48 have now been cancelled. Thus, it is respectfully submitted that the Examiner's rejections under § 112 are no longer applicable.

In view of the Amendment filed May 6, 2004, and the cancellation of dependent claims 46 and 48 as explained above, claims 18, 19, 21-26, 28-45, and 47 are presently pending in this application. In the outstanding Office Action, the Examiner rejected claims 18, 19, 21-23, 28-39, 41-43, 45, and 47 under 35 USC § 103(a) as being unpatentable over the Mashino reference (USP 6,545,353) in view of the Glenn reference (USP 6,291,884); and rejected claims 24-26, 40, and 44 as being unpatentable over the Mashino reference in view of the Glenn reference, and further in view of the Okabe reference (U.S. Application 2002/0118523). However, the Examiner's prior art rejections are respectfully traversed. For the reasons discussed below, it is respectfully that the claims are clearly patentable over the prior art of record.

As an initial matter, the Examiner is requested to note that this application presently contains two independent claims - independent claim 18 and independent claim 32. During the interview of October 18, 2004, the Examiner was requested to clarify several points that were made in the outstanding Office Action of July 14, 2004. In particular, the Examiner was requested to clarify how the references of record teach several limitations recited in independent claims 18 and 32. As will be explained below, it is submitted that the prior art references of record do not disclose or even suggest all of the elements recited in each of independent claims 18 and 32.

Firstly, independent claim 18 as amended in a response filed May 6, 2004 is directed to a multi-layer board that comprises a ceramic layer, an impedance element on the ceramic layer, and

a first resin layer over the first side of the ceramic layer. Independent claim 18 further recites that the first resin layer has a dielectric constant *lower than* the dielectric constant of the ceramic layer. As previously explained in the remarks submitted with the Amendment filed May 6, 2004, because the dielectric constant of the first resin layer is lower than the dielectric constant of the ceramic layer, a strip line formed on the surface of the first resin layer can be wide, thereby producing a reduced loss, which is particularly preferable for improving a noise factor during high frequency performance.

On page 3 of the outstanding Office Action of July 14, 2004, the Examiner asserted that the Mashino reference discloses a first resin layer 105 "*inherently* having a dielectric constant lower than said dielectric constant of said ceramic layer" (emphasis added). Although the Examiner's position is not entirely clear, it *appears* that the Examiner is taking the position that a resin layer will *always* have a dielectric constant lower than that of a ceramic layer. If this is an accurate restatement of the Examiner's position, the Applicant respectfully disagrees with the Examiner. As support for the Applicant's position that resin layers <u>do not</u> always or inherently have dielectric constants that are lower than those of ceramic layers, the Applicants have submitted herewith information in Appendix A and Appendix B for the Examiner's consideration. In particular, Appendix A includes a table prepared by Kyocera Corporation, which indicates that an alumina-based ceramic material has a dielectric constant ranging approximately between 8.5 and 9.5. Meanwhile, Appendix B includes an abstract from an Institute of Electrical and Electronics Engineers (IEEE) paper, indicating a resin (vinylidene flouride-hexafluoropropylene) has a dielectric constant of 13.9. Thus, because the resin discussed in Appendix B clearly has a *higher* dielectric constant (13.9) than the ceramic material discussed in Appendix A (8.5-9.5), it is submitted that these references clearly illustrate that resin materials do not *inherently* have dielectric constants that are lower than ceramic materials.

During the interview of October 18, 2004, the Examiner indicated that he would attempt to clarify his rejection of independent claim 18 by providing more evidence, such as a new reference. In this regard, however, the Examiner is requested to note that the invention recited in claim 18 is not directed merely to a resin material that has a dielectric constant lower than a ceramic material. In contrast, the invention recited in independent claim 18 is directed to a multi-layer board with

numerous elements, including a ceramic layer, an impedance layer on the ceramic layer, and a first resin layer over the ceramic layer. Furthermore, these elements are specifically designed so that the first resin layer has a dielectric constant lower than the dielectric constant of the ceramic layer. Thus, even if the Examiner is able to find a prior art reference that merely teaches that a resin material *can* have a dielectric constant lower than a ceramic material, it is submitted that such a reference alone would not motivate one of ordinary skill in the art to modify the Mashino reference to obtain the present invention as recited in claim 18. In other words, the Examiner must provide evidence that would teach one of ordinary skill in the art to arrange a resin layer and a ceramic layer, with dielectric constants having the relationship discussed above, in the manner recited in claim 18.

The Glenn reference and the Okabe reference also <u>do not</u> disclose or suggest a multi-layer board including a ceramic layer and a first resin layer over the ceramic layer, in which the first resin layer has a dielectric constant lower than the dielectric constant of the ceramic layer. Therefore, one of ordinary skill in the art would not be motivated by these references to modify the Mashino reference or to combine the references in a manner that would result in the invention recited in independent claim 18. Accordingly, it is respectfully submitted that independent claim 18 and the claims that depend therefrom are clearly patentable over the prior art of record.

Independent claim 32 is directed to a multi-layer board that comprises a ceramic layer, an impedance element including a *patterned inductor* on the ceramic layer, and a resin layer over the first side of the ceramic layer, in which the resin layer has a first side facing the first side of the ceramic layer and has a second side opposite the first side of the resin layer. The multi-layer board of claim 32 also comprises a ground pattern on the second side of the resin layer, and the ground pattern and the pattern inductor are arranged so that *no portion of the ground pattern is located on a portion of the second side of the resin layer opposite a portion of the first side of the resin layer facing the patterned inductor*, so as to increase a Q-factor of the patterned inductor. In other words, the multi-layer board of claim 32 is arranged so that the ground pattern does not oppose the patterned inductor via the resin layer, as illustrated in Figure 1 of the present application (for a further explanation of this arrangement and the advantages achieved therefrom, the Examiner is referred to the remarks submitted with the Amendment filed May 6, 2004).

On page 5 of the outstanding Office Action, the Examiner asserted that the combination of the Mashino reference and the Glenn reference discloses all of the limitations of claim 32, except an impedance element comprising a patterned inductor. However, the Examiner did not specifically explain anywhere in the Office Action how the combination of references teaches the relationship between the ground pattern and the patterned inductor as recited in the last four lines of claim 32. In fact, in the Interview Summary Sheet prepared following the Interview of October 18, 2004, the Examiner acknowledged that "the cited art does not sufficiently show the position of the ground layer and the inductor device." Thus, because the prior art does not show the position of the ground layer and the inductor device, it is not seen how the prior art can disclose the specific relationship between the patterned inductor and the ground pattern as recited in claim 32. In fact, it is submitted that the combination of the Mashino reference, the Glenn reference, and the Okabe reference does not disclose or even suggest the arrangement of the ground pattern and the patterned inductor as recited in claim 32. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the references so as to obtain the invention as recited in claim 32. Accordingly, it is respectfully submitted that independent claim32 and the claims that depend therefrom are clearly patentable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. However, if the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact the Applicant's undersigned representative.

Respectfully submitted,

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■ MATERIAL PROPERTIES GUIDELINES

CERAMIC MATERIAL OPTIONS		ELECTRICAL: DIELECTRIC CONSTANT 1MHz	ELECTRICAL: DIELECTRIC CONSTANT 2 GHz	ELECTRICAL: TAN d (x 10 -4) 1MHz	ELECTRICAL: TAN d (x 10 -4) 2 GHz	THERMAL: CTE (x10 -6) 1/C (RT-400oC)	THERMAL: Thermal Conductivity (W/mK)	MECHANICAL: Flexural Strength (MPa)	MECHANICAL: Young's Modulus of Elasticity (GPa)	CONDUCTOR MATERIAL
ALUMINA	A473	9.1	8.5	5	10	6.9	18	400	270	W, Mo, Thin Film
	A440	9.8	_	24	_	7.1	14	400	310	W, Mo
	A443	9.6	_	5	_	6.9	18	460	310	W, Mo
	A0600	9	8.8	10	21.0	7.2	15	400	260	Cu-W
ALUMINUM NITRIDE	AN271	8.8	8.6	1	152.0	4.7	150	450	310	W, Thin Film
	AN242	8.7	8.6	1	170	4.7	150	400	320	W, Thin Film
	AN75W	8.8	8.9	4	51	4.8	76	430	320	W
LTCC	GL550	5.6	5.6	6	9	5.9	2.0	200	110	Cu
	GL560	6.0	6.0	5	17	7.9	1.5	200	91	Cu
	GL660	9.4	9.6	2	17	6.2	1.2	200	100	Cu
MULLITE	ML751	6.5	_	13	_	4.1	4.4	270	190	_

* Data Listed above are Typical Value.

[PDF Full-Text (288 KB)] ABSTRACT PLUS

Giant electrostrictive response in poly(vinylidene fluoride-hexafluoropropylene) copolymers

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Abstract:
Electrostrictive strains were measured in three different polymeric materials: a low modulus polyurethane elastomer, previously studied by Scheinbeim et al. (1994), and two higher modulus random copolymers of poly(vinylidene fluoride-hexafluoropropylene) [P(VDF-HFP)] with 5% and 15% HFP content. Measurements at increasing voltage (electric fields ranging from 0 to 60 MV/m) were taken using an air gap capacitance system and then converted to sample thickness. Copolymer samples with different thermal histories were compared, ice water quenched, air quenched, and slow cooled, for both compositions. The ice water-quenched 5% P (VDF-HFP) copolymer exhibited the highest strain response (>4%) with a dielectric constant of 13.9. The previously studied polyurethane elastomer exhibited the second highest strain response, >3%, with the lowest dielectric constant, 8.5. The

ice water-quenched 15% HFP copolymer exhibited the lowest strain response among the three polymeric materials tested, /spl ap/3%, with a dielectric constant of 12.2. The strain energy density of the 5% HFP ice water-quenched copolymer, /sup 1///sub 2/ YS/sub m//sup 2/ (/sup 1///sub 2/ Young's modulus, Y, times the maximum electrostrictive strain, S/sub max/ squared), is the largest known for any semi-crystalline polymer: 0.88J/cm/sup 3/.

[PDF Full-Text (288 KB)] ABSTRACT PLUS